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THESIS

A Multivariate Analysis of Selected Socio-Economic Indicators in the Middle East

by

Michael W. Trahan

December 1983

Thesis Advisor: R. Looney

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A Multivariate Analysis of Selected Socio-Economic Indicators in the Middle East		5. TYPE OF REPORT & PERIOD COVERED Master's Thesis December 1983 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Michael W. Trahan		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940		12. REPORT DATE December 1983 13. NUMBER OF PAGES 80
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Middle East multivariate analysis

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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S/N 0102-014-6601

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A Multivariate Analysis of Selected Socio-Economic Indicators in the Middle East

by

Michael W. Trahan
Captain, United States Army
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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF ARTS IN NATIONAL SECURITY AFFAIRS

from the

NAVAL POSTGRADUATE SCHOOL
December 1983

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I. BACKGROUND

This study involves multivariate analysis of socio-economic data which would reflect the complex reality of the development levels and process.

Several attempts have been made over the years to classify Middle East countries on the basis of various socio-economic indicators. Although providing useful insights as to the development process taking place in the region, these initial studies were limited by the relative lack of data for several countries [Ref. 1]. As a result few empirical studies along these lines have been performed. The recent publication by the World Bank of a compilation of socio-economic data for developing countries has removed a major barrier to the application of sophisticated statistical analysis of the regions development patterns.

The main objective of this study is, 1.) the construction of socio-economic indices for twenty-one Middle East countries; and 2.) The use of these indices to rank and scale the countries according to their socio-economic development levels.

The main purpose of the indices is in predicting individual countries levels of development over time, through identifying those factors which appear critical in

influencing the growth pattern of this group of countries. Hopefully this analysis will aid policy makers in identifying various factors indicative of immediate development potential of the countries of the Middle East, and armed with this criteria enable them to identify a set of promising countries as foreign aid recipients.

The initial work in this field was performed by Z.Y. Hershlag and Z. Kloner [Ref. 2]. The period covered was 1960-1965. While yielding several useful insights (Table I), their results have clearly been made obsolete by two Arab-Israeli confrontations; an inter-Arab war (Iran-Iraq): and an Islamic revolution in Iran [Ref. 3].

Given the availability of a large number of socio-economic variables and no a priori basis of selection as to their relative importance in classifying countries, the first stage in the analysis employed a factor analysis to reduce the number discriminating variables to a small set of relatively uncorrelated indices.

A principal component analysis was carried out in order to determine the number of independent factors in the data set. The criterion for factor inclusion was simply that each factor selected must make a significant marginal contribution to the explanation of the total variance of the original set of variables, i.e. the variables chosen for the subsequent cluster and discriminant analysis were selected on the basis of posessing the highest factor loadings for

TABLE I

Results of the Hershlag - Kloner Study

Rank Order	Country	Average Rank Order
1	Kuwait	1.5
2	Israel	2.0
3	Cyprus	4.0
4	Lebanon	4.0
5	Libya	6.5
6	Jordan	7.0
7	U.A.R.	7.5
8	Iran	8.5
9	Turkey	9.0
10	Iraq	9.0
11	Saudi Arabia	9.5
12	Syria	10.0
13	Sudan	12.5

each of the identified, independent, and statistically significant factors. At this point Hershlag and Kloner ceased their analysis assigning each country to a group which its parameter most closely approximates. This, in essence, is the same approach used by Adleman and Morris [Ref. 4].

The next step in the analysis was that of classifying countries on the basis of the unique socio-economic characteristics identified in the factor analysis.

This step entailed a statistical analysis of variance to derive functions best capable of discriminating among groups in the sense that they represented those linear combinations of characteristics, each of which, given the preceeding variables, maximized the remaining distance between the square of the group means and the variance within groups. The discriminant functions thus obtained were then used to classify countries into unique performance groups. The probability that a given country was correctly classified as belonging in a group was also computed.

Since the study was undertaken without any preconceived notions concerning country groupings and, a much larger data base was drawn upon than that available to Hershlag and Kloner, it was felt a combination of these two techniques was necessary. Hershlag and Kloner first divided indicators into two groups, economic and non-economic variables. A rank order of countries was then established, based upon an average of the two scores achieved in each of those areas. Clearly, from purely a statistical point of view, it should be possible for the present study to obtain a more solid ranking of countries due to the fact that the factor analysis was run for a greater sample size (21 versus 13 countries), in the same data run.

II. SELECTION AND EXPLANATION OF THE VARIABLES

Since the analysis was multivariate, a major initial problem involved the choice and selection of explanatory variables. The authoritative United Nations Documents such as, "The Report on International Definition and Measurement of Standards of Levels of Living", and the "System of Overall Review and Appraisal of the Objectives and Policies of the International Development Strategy", provided the initial data base.

An attempt was made to cover the major sectors of social and economic development in a relatively balanced manner. The procedure used in the selection of indicators was basically one of progressive elimination. A relatively large number of possible indicators were first considered - indicators which existed (fourty variables were present from the Hershlag -Kloner study), or could be constructed. A substantial proportion of these were rejected, either because the series lacked observations for one or more countries, were not comparable, or on closer inspection were not conceptually suitable for a comparative measurement of socio-economic development. Among important variables which could not be included due to one or more of the above problems were:

- environmental indicators
- employment indicators

- income distribution indicators
- land tenure indicators
- indicators of human freedom

The variables selectei fell into one of three types:

1. Variables of a percentage-type showing the extent of spread in a country of a condition or (an attribute) generally considered desirable, i.e., the percentage of the adult population that is literate; the percentage of school age population enrolled in school, etc.

2. Variables of a per capita-type: per capita national income, per capita value of foreign trade, consumption per capita, etc. In most cases, these variables reflected economic measures of one sort or another. For some variables, it should be noted, data is expressed in both a per capita form and a percentage form.

3. Structural indicators, which, like the the first type, are percentage indicators: percentage of salaried and wage earners in the economically active population, percentage of GDP derived from manufacturing, etc.

In general, in the selection of variables, only those variables commonly refered to in the literature [Ref. 5], as reflective of the forces usually specified by the major factors of development were reflected. In summary, the following criteria of variable selection can be given:

1. Avaiability of Data- whether a sufficent number of countries have data on the variable, or data from the variable can be construed;

2. Comparability- whether the variable is operationally defined in the same way and used to count or measure the same things in different countries;
3. Quality of Data- whether the data is collected by adequate means, is consistent with one another, and otherwise reliable;
4. Validity of Indicator- whether the indicator measures what it is intended to measure. This involves both statistical validity and conceptual validity. (Thus a variable like, relative number of hospital beds in a country may be a statistically valid measure of hospital facilities, but the assumption underlying its use as a development indicator- that it is a good measure of national health level- may not be valid.);
5. Discriminative Power- whether the variable effectively distinguishes between countries at different levels of development, particularly between Middle East countries.

Since the goal is to compare and classify countries according to their socio-economic levels, the variables must be utilized in their relative magnitudes - eliminating scale differences among the countries. The actual variables selected for the following analysis were;

A. VARIABLES

1. Direct taxes as a percent of total government revenues - DIRTAX [Ref. 6].
2. Indirect taxes as a percent of total government revenues - INDIRTAX [Ref. 7].
3. Non-tax government revenues as a percent of total government revenues - NONTAX [Ref. 8].
4. Security expenditures as a percent of total government expenditure - SECEXP [Ref. 9].
5. GNP per capita at factor costs - GNPPRCAP [Ref. 10].
6. Agriculture product as a percent of GDP - AGRIPROD [Ref. 11].
7. Industrial product as a percent of GDP - INDUSPRO [Ref. 12].
8. Administration as a percent of GDP - ADMINGDP [Ref. 13].
9. Mining, water, and electricity as a percent of GDP - MIWAELEC [Ref. 14].
10. National savings as a percent of national income - NATSAV [Ref. 15].
11. GDP as a percent of total sources - GDPSOURC [Ref. 16].
12. Private consumption as a percent of total national expenditure - PRICONNE [Ref. 17].

13. Government consumption as a percent of total national expenditure - GOVCONNY [Ref. 18].
14. Gross investment as a percent of GDP - GROSINV [Ref. 19].
15. Private consumption as a percent of GDP - PRIVCON [Ref. 20].
16. Government consumption as a percent of GDP - GOVCON [Ref. 21].
17. Exports as a percent of GDP - EXPERGDP [Ref. 22].
18. Economically active population as a percent of total population (gross participation rate) - ECOACPOP [Ref. 23].
19. Public expenditure on education as a percent of total government expenditure - PUBEXED [Ref. 24].
20. Education expenditure as a percent of GDP - EDEXPEN [Ref. 25].
21. Girls enrollment in primary education as a percent of total enrollment - FEMPRIM [Ref. 26].
22. Girls enrollment in secondary education as a percent of total enrollment - FEMSECED [Ref. 27].
23. Girls enrollment in tertiary education as a percent of total enrollment - FEMTERDE [Ref. 28].
24. Primary education enrollment as a percent of total age group - PRIMED [Ref. 29].
25. Secondary education as a percent of total age group - SECED [Ref. 30].

26. Tertiary education enrollment as a percent of total age group - TERTED [Ref. 31].
27. Pupil-Teacher ratio in primary education - PUPTEACH [Ref. 32].
28. Illiterates 15 years of age and over as a percent of total population in this age group - ILLITER [Ref. 33].
29. Daily newspaper distribution per 1000 inhabitants - DAILNEWS [Ref. 34].
30. Radio receivers per 1000 inhabitants - RADREC [Ref. 35].

III. DATA AND DATA PROCESSING

TABLE II

Countries Included in the Analysis

1. Algeria	12. Oman
2. Bahrain	13. Qatar
3. Egypt	14. Saudi Arabia
4. Iran	15. Sudan
5. Iraq	16. Syria
6. Israel	17. Tunisia
7. Jordan	18. Turkey
8. Kuwait	19. United Arab Emirates
9. Lebanon	20. Yemen (Sana)
10. Libya	21. Yemen (PDRY)
11. Morocco	

Twenty-one countries are included in this study. The countries in alphabetical order, are listed in Table II . The data collected refers to the period 1975-1980; the bulk of it is for 1977.

Thirty variables were chosen on the basis of their role in describing the socio-economic system and in accordance with the criteria established in Chapter Two. With a total of twenty-one observations (cases) and thirty variables, the

data set consisted of a possible 530 pieces of information. Due to the nature of the SAS (Statistical Analysis System) program, any observations (observation=country) with missing values were automatically deleted from the analysis. Bahrain, Qatar, United Arab Emirates, and the Peoples Democratic Republic of Yemen (PDRY), were thus deleted from both the factor and the discriminant analysis. Therefore the data set analyzed, consisted of seventeen (17) observations and thirty (30) variables for a total of 510 values. (Appendix A).

In cases of variables expressed in monetary terms, conversion to U.S. dollars was made according to the official rate of exchange in force in the relevant year. Three data processing techniques were used.

A. FACTOR ANALYSIS

First the independent variables were factor analyzed. The SAS program used, computed the following statistics

a. means, standard deviations, number of observations and variable lables.
b. a correlation matrix for the variables in the analysis. (Pearson Correlation)
c. prior estimates of communalities.
d. eigenvalues.
e. initial factor loadings.
f. communality estimates.
g. the orthogonally rotated factor matrix.
h. plots of the factor patterns.
i. the scoring coefficent matrix.

By determining common variance among the variables, the SAS factor analysis reduced the number of independent variables for the discriminant analysis and more importantly the factor analysis selected variables that were largely uncorrelated with one another. The principal components method of factor analysis was used. Factors were extracted that had eigenvalues of at least 1.0. The seven factors which met this criteria were then orthogonally rotated using the SAS VARIMAX procedure. These factors collectively accounted for 91.1 per cent of the total variance in the matrix. Loadings of the thirty independent variables are reported in Table III.

Factor 1 appears to reflect the total level of economic development of the country; Factor 2 - The level of educational development; Factor 3 - The extent of government current expenditures; Factor 4 - The stage of social and cultural development; Factor 5 - The level of private consumption; Factor 6 - Government revenues; and Factor 7 - The level of defense spending.

B. CLUSTER ANALYSIS

In order to identify the different groups of observations having similar attributes a hierarchial cluster analysis was performed [Ref. 36]. The chief advantage of this technique is that it requires no a priori specification

TABLE III

Factor Loadings of the Thirty Independent Variables

FACTOR ANALYSIS OF MIDEAST SOCIO-ECONOMIC INDICATORS

ROTATED FACTOR PATTERN

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6	FACTOR7
CIRTAX	-0.64334	-0.24441	0.32550	0.05997	0.01661	-0.15158	-0.17730
INDIRTAX	-0.68345	0.14994	0.56405	0.09352	0.20932	-0.11781	-0.11232
NONTAX	0.84918	0.20820	-0.29973	-0.05650	-0.00384	0.12914	0.17260
SECEXP	0.26667	-0.18666	0.21459	-0.08529	0.03176	0.88138	0.23008
GNPPRCAP	0.71139	0.23496	0.04263	0.14140	-0.57087	0.10222	-0.10110
AGPIPPCD	-0.75911	-0.35794	-0.20981	-0.26840	-0.23586	-0.22793	-0.02704
INDUSPRC	0.86297	0.11085	0.04470	-0.03190	-0.05118	-0.02411	0.16348
ADMINGDP	-0.38727	0.09712	0.80236	0.24873	-0.07265	-0.04482	0.19871
MINAELEC	0.95101	0.11610	-0.02778	0.09560	-0.12629	0.00436	0.14357
NATSAV	0.79298	-0.02154	-0.22796	-0.15612	-0.08430	0.23310	-0.29539
GDPSOLPC	0.66835	-0.38274	0.01163	0.13458	0.40585	0.32011	-0.15417
PRICRANE	-0.56917	-0.00575	-0.02628	0.06742	-0.01339	0.13490	-0.07651
GOVCRANE	0.03526	0.19392	0.87012	0.06558	-0.08099	0.23985	0.25346
GROSINV	-0.10747	0.18723	-0.00086	-0.01544	0.90232	0.09968	0.03826
PRIVCON	-0.97684	0.06992	-0.12654	-0.04464	0.01201	0.04077	0.03491
GOVCON	0.25728	-0.03217	0.48616	0.09014	0.29278	0.10762	0.72728
EXPERGDP	0.66895	0.20340	0.02717	0.22973	-0.07635	0.18643	0.13630
ECCACPCP	-0.27492	-0.81362	0.07461	-0.39224	0.06305	-0.02542	0.00730
PUBEXEC	-0.49727	0.10016	-0.14833	-0.15737	0.17121	-0.36847	-0.69124
EDEXPEN	0.11106	0.08369	0.79240	-0.38318	0.04395	0.09708	-0.12330
FEMPRIM	0.09854	0.87470	0.10238	0.19832	0.13466	-0.10840	-0.15990
TERTED	-0.36964	0.54527	0.29683	0.48643	0.05720	0.36297	0.04577
FEMSECED	0.16943	0.60377	0.50895	-0.05190	-0.16320	-0.19330	-0.12682
FEMTERCE	-0.15522	0.48014	0.74498	0.12738	0.02101	0.12429	0.22745
PRIMED	0.13224	0.90932	0.11460	-0.02768	0.21782	-0.14603	0.00317
SECED	0.12185	0.87181	0.29581	0.13649	-0.15616	0.15463	0.20175
PUPTEACH	-0.48979	-0.46937	-0.15914	-0.41015	0.27885	-0.42937	0.04262
ILLITER	0.00390	-0.39264	-0.23085	-0.81305	-0.05165	0.09499	0.05463
CATLNETS	0.00163	0.33885	0.47141	0.61359	-0.48131	-0.00637	0.00283
RADREC	0.14494	0.04082	-0.26542	0.87592	-0.02433	0.02935	0.18055

ORTHOGONAL TRANSFORMATION MATRIX

	1	2	3	4	5	6	7
1	0.90938	0.30355	0.03815	0.16191	-0.09123	0.17540	0.11886
2	-0.31869	0.64178	0.60327	0.33781	-0.03047	0.02641	0.08320
3	0.07711	-0.66732	0.65014	-0.23484	0.07597	0.34481	0.36631
4	0.13123	0.33681	0.19899	-0.76158	0.35814	-0.25984	-0.22227
5	-0.09281	0.05622	-0.21079	0.24203	0.89086	0.18694	0.25332
6	-0.21425	0.13904	-0.32035	-0.37735	-0.20773	0.72194	0.19096
7	0.03625	-0.11738	0.15899	0.15344	0.14116	0.47537	-0.83077

VARIANCE EXPLAINED BY EACH FACTOR

FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6	FACTOR7
9.486340	5.185089	4.354575	2.914100	2.003117	1.757672	1.622545

of an underlying model of development. The method thus provides a high degree of objectivity. Operationally, the

technique begins by forming one cluster for each observation. The two closest clusters are then combined into one cluster, followed by the closest of the new cluster groupings combined into one cluster, and so on. The SAS CLUSTER procedure computes its own distance matrix; the metric being Euclidean.

Letting Xi denote the i th observation vector, the distance between the two observations can be written as :

$$d\ (xi\ xj) = (xi - xj)' (xi - xj)$$

CLUSTER will then standardize the distance matrix by dividing each element by the average distance from the vector of variable means: i.e. by

$$d = n \sum \left[d(xi, \bar{x}) \right]$$

where n is the number of observations in the data set.

The distance between two clusters is defined as the maximum distance between an observation in one cluster and an observation in the other cluster.

The independent variables selected for the cluster analysis were those which had the highest factor loadings, respectively, on each of the seven factors: Private consumption as percentage of GDP, Primary education enrollment as percentage of total age group, Government consumption as percentage of total national expenditure, Radio receivers per 1000 inhabitants, Gross investment as percentage of GDP,

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Public expenditure on education as percentage of total government expenditure, and defense expenditures as percentage of total government expenditures.

As noted, four of the the observations (Bahrain, Qatar, PDRY, UAE), were missing one or more of the selected independent variables, and thus were omitted from the analysis. The results are portrayed in Table IV, in a cluster map, while Table V details a listing of observations within each cluster. Four logical groups of countries were derived on the basis of the cluster analysis.[1]

C. DISCRIMINANT ANALYSIS

To determine the extent to which the independent variables could correctly determine the levels of socio-economic development within the selected Middle East countries, a discriminant model was constructed, through the use of the SAS DISCRIM procedure. This model was then utilized to cross check the cluster analysis by classifying the sample countries into one of four groups.

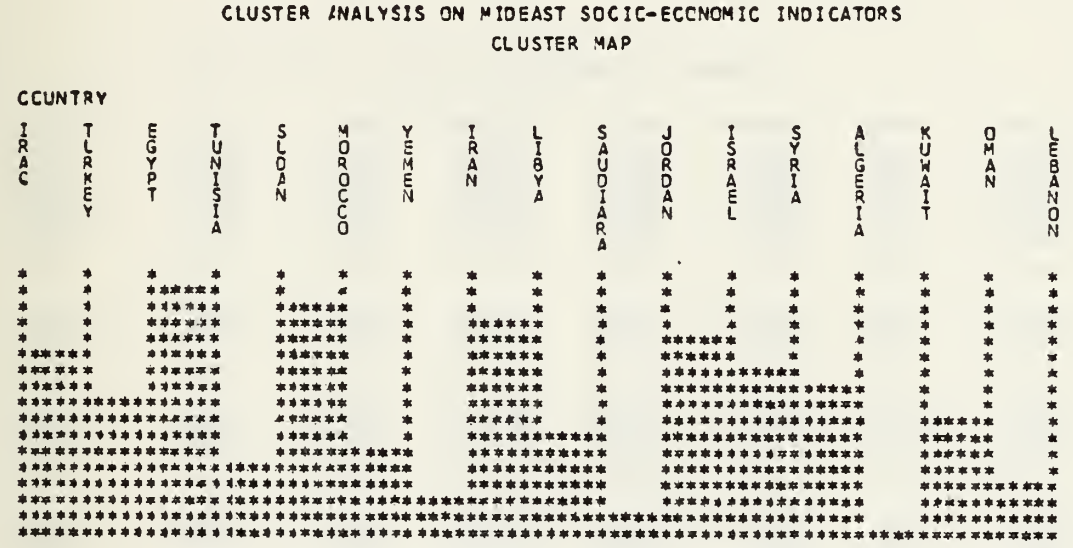
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[1]Based upon a knowledge of the region and upon review of the previous study (Herschlag-Kloner), it was felt four initial groups would provide the most convenient size for further analysis.

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TABLE IV

A Cluster Map of Socio-Economic Groupings



The model, also known as a classification criterion, is determined by a measure of generalized squared distance. Two discriminant functions were computed. The first based upon the individual within group convariance matrices; the second on the pooled convariance matrix.

The independent variables selected for the discriminant analysis, were the same ones which had been used in the hierarchial cluster analysis; those variables with the highest loadings, respectively, on each of the seven factors.

TABLE V

Clusters Based Upon Seven Independent Variables

CLUSTER ANALYSIS ON MIDEAST SOCIO-ECONOMIC INDICATORS

CLUSTER LISTING

COUNTRY	AGREC	SECEXP	GROSINV	PRIVCON	GOVCONS	PRIMED	PUBEXED
IRAQ	113.100	33.6000	25.7000	54.5000	16.8000	120.0	6.9000
TURKEY	104.200	15.6000	22.4000	71.2000	16.3000	105.0	19.9000
EGYPT	126.400	8.8000	20.4000	63.8000	21.5000	75.0	16.8000
TUNISIA	140.600	4.2000	26.2000	64.9000	15.9000	102.0	18.6000
SUDAN	73.400	13.6000	13.8000	80.6000	14.0000	51.0	15.7000
MOROCCO	80.000	16.3000	23.9000	65.5000	21.3000	75.0	15.6000
YEMEN	141.000	37.5000	19.6000	93.1000	12.7000	34.0	11.9000
MEAN	112.671	18.5143	21.7143	71.0857	17.0143	80.3	15.0571
IRAN	62.300	26.4000	27.1000	41.3000	18.6000	101.0	14.1000
LIBYA	47.000	20.8000	25.0000	28.8000	21.4000	123.0	13.0000
SAUDIARA	28.400	56.9000	19.4000	13.6000	21.0000	64.0	11.6000
MEAN	45.900	35.7000	23.8333	27.9000	20.3333	96.0	12.9000
JORDAN	196.800	43.2000	38.7000	80.8000	32.8000	102.0	9.5000
ISRAEL	189.000	38.9000	22.3000	58.0000	40.8000	96.0	8.3000
SYRIA	224.000	26.4000	28.0000	66.2000	20.4000	96.0	9.6000
ALGERIA	178.700	8.8000	46.2000	46.6000	14.0000	98.0	17.3000
MEAN	197.125	30.0750	33.8000	62.9000	27.0000	98.0	11.2250
KUWAIT	460.800	19.5000	8.0000	17.1000	21.1000	99.0	5.9000
OMAN	421.000	36.8000	28.2000	11.4000	18.1000	44.0	4.9000
LEBANON	460.400	19.6000	30.5000	86.0000	9.0000	97.0	18.6000
MEAN	447.400	24.9667	22.2333	38.1667	16.0667	80.0	9.8000

In the first discriminant function, a test of the homogenity of within convariance matrices, the chi-square value was not significant at 0.5000 level, therefore it was decided to utilize a pooled convariance matrix within the discriminant function.

In the discriminant analysis the data from seventeen countries (four were excluded due to missing values), and the seven variables were entered into the discriminant function. The F to enter significance level for the variables was 0.05. Table VI shows that 17 of the 17 countries were classified correctly, with the average probability of correct classification for all countries greater than 99.0 percent.

TABLE VI

The Posterior Probability of Correct Classification

OBS	FROM CLUSTER	CLASSIFIED INTO CLUSTER	1	2	3	4
1	1	1	1.0000	0.0000	0.0000	0.0000
2	1	1	1.0000	0.0000	0.0000	0.0000
3	2	2	0.0000	1.0000	0.0000	0.0000
4	1	1	1.0000	0.0000	0.0000	0.0000
5	2	2	0.0000	0.9999	0.0000	0.0001
6	1	1	1.0000	0.0000	0.0000	0.0000
7	3	3	0.0000	0.0000	1.0000	0.0000
8	4	4	0.0000	0.0000	0.0000	1.0000
9	2	2	0.0000	1.0000	0.0000	0.0000
10	2	2	0.0000	0.9996	0.0000	0.0004
11	3	3	0.0000	0.0000	1.0000	0.0000
12	4	4	0.0000	0.0501	0.0000	0.9499
13	4	4	0.0000	0.0000	0.0000	1.0000
14	4	4	0.0000	0.0067	0.0000	0.9933
15	1	1	1.0000	0.0000	0.0000	0.0000
16	2	2	0.0000	0.9997	0.0000	0.0003
17	2	2	0.0000	0.9970	0.0000	0.0030

A major advantage of discriminant analysis over cluster analysis is the formation of one or more linear combinations of the discriminating variables. These "discriminant functions" are of the form:

$$Di = di2 + di2Z2 + \ldots\ldots + dipZp$$

where Di is the score on discriminant function i, the d's are weighting coefficents; and the Z's are the standardized values of the p discriminating variables used in the analysis. [Ref. 37].

The maximum number of functions which can be derived is either one less than the number of groups or equal to the number of discriminating variables, if there are more groups than variables. Ideally, the discriminant scores (D's) for the cases within a particular group will be fairly similar. The functions are formed in such a way to maximize the seperation of the groups.

Since the SAS DISCRIM program does not derive a discriminant score, computations were made using the SPSS (Statistical Package for the Social Sciences) Discriminant Analysis Program. As with the SAS program, variables were eliminated through a sequential process so that those remaining contained the majority of the classificatory information. The results served to cross validate the results achieved by our factor analysis.

The data was processed with the help of SAS and SPSS programs run on the IBM 370, Naval Postgraduate School computer.

IV. RESULTS OF THE ANALYSIS

A. RESULTS OF THE FACTOR ANALYSIS

The first step in grouping the sample countries involved a factor analysis to delineate patterns of variation in the sample of socio-economic variables (or what is more commonly refered to as an R-factor analysis.)

Loadings of the 30 independent variables on the selected factors are reported in Table III Those variables posessing the highest factor loadings for each of the factors were considered most represenative of the socio-economic forces represented by that factor. Based on the factor loadings (Table III), the first factor depicts the overall economic development of a country. A country scoring highly on this factor could be expected to have a strong, stable, self sufficient economy, built upon a stable agricultural and industrial base. GNP per capita could also be expected to be higher than those of the other country groupings. The same applies to private consumption.

The second factor reflects the development and spread of education as evidenced by a high percentage of an economically active population. The development of primary education appears particularly critical in this regard.

Factor three appears to indicate the overall development of widespread government services and cultural progression. This is evidenced by the high loading for female tertiary education (in predominantly male dominated societies), as well as the high loading for the percentage of population subscribing to daily newspapers. The degree of government consumption, and the high percentage of administration expenditures, would seem to indicate an established government bureaucracy, normally reflective of a society posessing a high degree of political stability.

Factor four depicts the cultural or social level of a country, where Factor five represents the degree of mobilization of resources for productive activity. Factor six further indicates the degree of sophistication of the public sector in administering and collecting revenues. Factor seven clearly refers to the level of defense expenditures. To summarize up to this point, having taken thirty variables, and subjecting them to an R-factor analysis, seven independent variables have been identified. Given their low degree of correlation and the fact that they represent a wide spectrum of socio-economic forces these variables were considered suitable for the cluster and discriminant analysis that follows.

B. RESULTS OF THE CLUSTER ANALYSIS

The variables that loaded most highly on the seven independent factors were then selected to aid in the establishment of four preliminary independent groups, through the use of the SAS Cluster Analysis Program. The variables having the highest loadings on their respective factor are exhibited in Table VII.

TABLE VII

The Highest Loadings in Each of the Seven Factors

Factor	Variable	Variable#	Factor Loading
1.	PRIVCONN	15	-0.98648
2.	PRIMED	24	-0.91237
3.	GOVCONNE	13	0.89509
4.	RADREC	30	-0.89629
5.	GROSINV	14	0.90839
6.	PUBEXED	19	0.65633
7.	SECEXP	4	0.89070

Upon review of the seven factors it was felt Factor 4- The Social Cultural Indicator- did not present a true indication of a country's development potential based upon the fact it was extremely dependent on the size of a country's population:item ratio and presented a skewed figure when

countries of diverse population sizes were compared with one another. The cluster analysis utilized the remaining six factors. Table VIII shows the results of the cluster analysis and the initial groupings of our seventeen countries.

C. RESULTS OF THE DISCRIMINANT ANALYSIS

The independent variables selected for the discriminant analysis were the same as those used in the cluster analysis, those having the highest loadings , respectively, on each of the six factors. The SPSS stepwise discriminant program then scanned these variables, selecting those which best explained the variance between the means of the four groups, given the other variables previously included.

As Table IX indicates, in the discriminant analysis, using data from all seventeen countries , five of the independent variables were entered into the functions; PRIVCON, PRIMED, GOVCONNE, GROSINV, SECEXP.

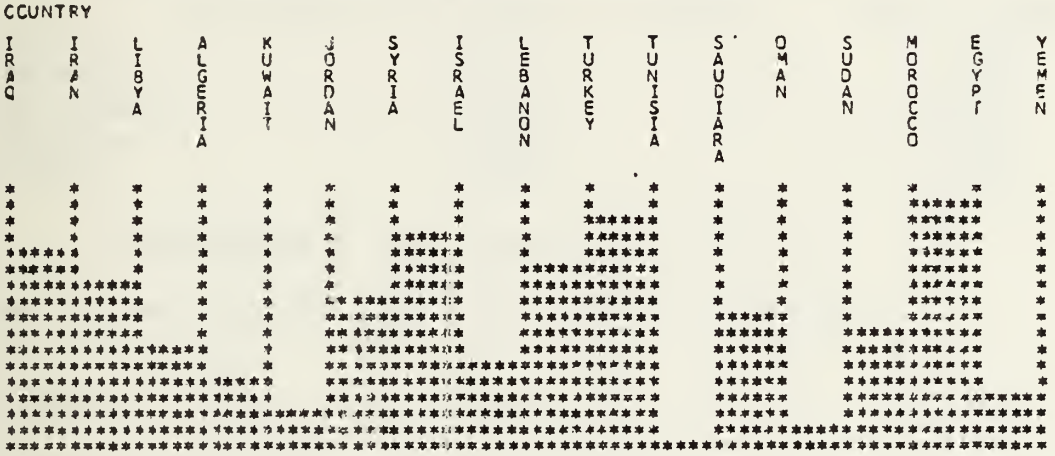
The first standardized 17 country function in Table X shows that Private consumption as a percentage of the GDP variable was the best discriminator followed by, Government consumption as a percentage of the total national expenditure, then Defense expenditures as a percentage of total government expenditure, with the Gross investment total as a percentage of the GDP and Primary education enrollment following.

TABLE VIII

Results of Second Cluster Analysis

CLUSTER ANALYSIS ON MIDEAST SOCIC-ECCNOMIC INCICATORS

CLUSTER MAP



CLUSTER ANALYSIS ON MIDEAST SOCIO-ECONOMIC INDICATORS

CLUSTER LISTING

	COUNTRY	SECEXP	GROSINV	PRIVCON	GOVCONNE	PRIMED	PUBEXED
1	IRAQ	33.6000	25.7000	54.5000	16.8000	120.0	6.9000
1	IRAN	29.4000	27.1000	41.3000	18.6000	101.0	14.1000
1	LIBYA	20.8000	25.0000	28.8000	21.4000	123.0	13.0000
1	ALGERIA	8.8000	46.2000	46.6000	14.0000	98.0	17.3000
1	KUWAIT	19.5000	8.0000	17.1000	21.1000	99.0	5.9000
1	MEAN	22.4200	26.4000	37.6600	18.3800	108.2	11.4400
2	JORDAN	43.2000	38.7000	80.8000	32.8000	102.0	9.5000
2	SYRIA	29.4000	28.0000	66.2000	20.4000	96.0	9.8000
2	ISRAEL	38.9000	22.3000	58.0000	40.8000	96.0	8.3000
2	LEBANON	19.6000	30.5000	86.0000	9.0000	97.0	18.6000
2	TURKEY	15.6000	22.4000	71.2000	16.3000	105.0	19.9000
2	TUNISIA	4.2000	26.2000	64.9000	15.9000	102.0	18.6000
2	MEAN	25.1500	28.0167	71.1833	22.5333	99.7	14.1167
3	SAUDIARA	56.9000	19.4000	13.6000	21.0000	64.0	11.6000
3	OMAN	35.8000	28.2000	11.4000	18.1000	44.0	4.9000
3	MEAN	46.3500	23.8000	12.5000	19.5500	54.0	8.2500
4	SUDAN	13.6000	13.8000	80.6000	14.0000	51.0	15.7000
4	MOROCCO	16.3000	23.9000	69.5000	21.9000	75.0	15.6000
4	EGYPT	8.8000	20.4000	63.8000	21.5000	75.0	16.8000
4	YEMEN	37.5000	19.6000	93.1000	12.7000	34.0	11.9000
4	MEAN	19.0500	19.4250	76.7500	17.5250	58.8	15.0000

TABLE IX

Stepwise Variable Selection for the 17 Countries

Variables included in the discriminant function

	F Ratios (to enter or remove)	Wilks Lambda
PRIVCON	93.518	0.1038
PRIMED	10.119	0.0141
GOVCONNE	10.453	0.0144
GROSINV	4.920	0.0085
SECEXP	12.048	0.0161

approximate F for function 11.759

Variables omitted from discriminant function

PUBEXED	0.74591	0.0025

sig .001

This function accounts for over 90 per cent of the overall variance.[2]

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[2]The second standardized function reached in our discriminant analysis, which accounts for 9 per cent of the total variance indicates that education is the largest contributing variable to the second function. This function will prove useful in plotting the overall development level of the countries in the following chapter.

The second standardized linear discriminant function is:

$$Zi = 1.04Bi - .208Ci + .153Di + .134Ei + .052Ai$$

TABLE X

Linear Discriminant Function

For the 17 Middle East Countries
non-standardized:

$Zi = -9.034 + .211Ai - .549Bi + .264Ci - .142Di - .154Ei$

standardized:

$Zi = 2.574Ai - .069Bi - 2.10Ci - 1.254Di - 1.993Ei$

A = PRIVCON
B = PRIMED
C = GOVCONNE
D = GROSINV
E = SECEXP

The signs preceeding the variables indicate the direction of their influence. Thus Middle Eastern countries can be expected to be more more developed if they have a high degree of both private and government consumption, an established defense organization, and a high rate of gross investment. Suprisingly, education does not appear particularly important in ranking these countries in terms of their level of development. In part this may simply reflect the fairly similar levels of education across countries. It may also be indicative of the fact the levels of the other variables are associated with the degree of educated populace.

In any case, it is clear that emphasis on education alone will not necessarily lead to a higher development level. Table XI summarizes the results of our analysis to this point. Four distinct groups of Mid Eastern countries have been achieved with a probability of correct classification average of greater than 90 percent reached. The discriminant score mean for each group clearly illustrates the distinction of the groups and allows us to rank the groups accordingly. A classification of the groups is now in order.

TABLE XI

Initial Country Groupings Based on Discriminant Score One

		Discriminant Score	Probability of Correct Class
Group I			
Iraq		-2.5	100%
Algeria		-3.9	100%
Iran		-4.3	100%
Kuwait		-4.5	100%
Libya		-4.7	100%
	mean	-4.03	
Group II			
Israel		4.2	99.4%
Turkey		4.1	99.9%
Jordan		3.95	100%
Tunisia		3.93	99.9%
Lebanon		3.6	99.9%
Syria		1.2	100%
	mean	3.53	
Group III			
Oman		-11.6	100%
Saudi Arabia		-12.5	100%
	mean	-12.06	
GroupIV			
Sudan		7.3	100%
Egypt		5.4	99%
Yemen		5.2	100%
Morocco		5.0	94%
	mean	5.77	

V. GROUP CLASSIFICATION

A tentative classification of country-type groups can be made, based upon specific variable characteristics for the countries in each group.

1. Group I
   a) a high enrollment rate in primary education
   b) a relatively high gross investment rate
   c) an average level of defense expenditures; an average private and government consumption rate
2. Group II
   a) the highest gross investment and government consumption rate
   b) the second highest level of defense expenditure; private consumption rate; and enrollment in primary education
3. Group III
   a) the highest level of defense expenditures
   b) the second highest government consumption rate
   c) an average gross investment rate
   d) the lowest private consumption rate; and primary education enrollment
4. Group IV
   a) the highest private consumption rate

b) an average primary education enrollment

c) the lowest level of defense expenditures; the lowest gross investment rate; the lowest government consumption rate.

Ranking our groups, based upon their discriminant scores would produce the following scale:

TABLE XII

Group Centroids of Middle East Clusters

Group IV	Group II	Group I	Group III
mean score 5.77	mean score 3.53	mean score -4.03	mean score -12.06

As stated earlier these discriminant scores are based upon the first discriminant function which accounts for 90 percent of the total variance. In order to achieve an even more exact ranking, the greater amount of variance which can be accounted for, the truer the ranking scheme.

By having the SPSS Discrim procedure compute a scatterplot of our cases using cannonical discriminant functions one and two as the X and Y axis a clearer indication of our ranking scheme can be realized. (Figure 5.1)

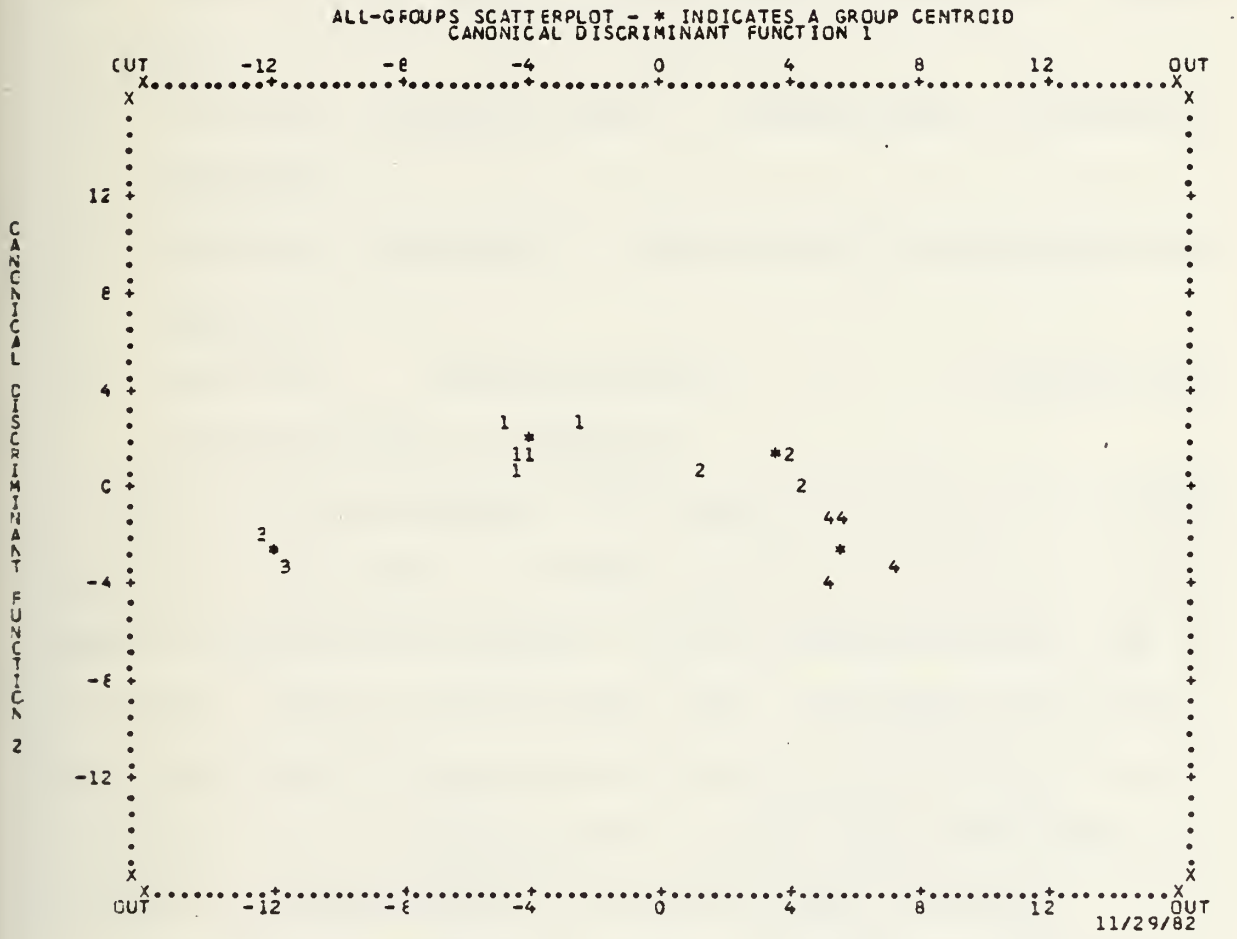


Figure 5.1 Scatterplot of Discriminant Functions 1 and 2.

The variables which contribute the most to function one,[3] are clearly economic in nature while the single

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[3] $Zi = 2.54Ai - .069Bi + 2.1Ci - 1.25Di - 1.99Ei$

variable which contributes the most to function two,[4] is educational in nature (indicative of social development).

Therefore our groups can be classified in one of four ways:

1. Socially Developed - Economically Developed: Group II
2. Socially Underdeveloped - Economically Developed: Group IV
3. Socially Developed - Economically Underdeveloped: Group I
4. Socially Underdeveloped - Economically Underdeveloped: Group IV

While having commenced the study having no a priori ranking of countries, a certain intuitive scaling of countries is inherently present. The results achieved up to this point clearly contradicted this intuitive hypothesis. While the cluster composition of the groups could in fact be explained, the discriminant scores achieved appeared inversely disproportional to what one might imagine.

Clearly the analytical methods pursued were correct. Therefore the flaw, whereby the oil producing countries as a group were classified as having the lowest levels of development, must lie in the manner in which the various socio-economic indices were constructed.

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[4] $Zi = 1.04Bi - .208Ci - .153Di + .134Ei + .052Ai$

The trap into which this researcher had fallen is one which is common in dealing with economic analyses of the Middle East. Due to the large amount of oil revenues received, after the OPEC price increases, expenditures as a percentage of the gross domestic product (GDP), are disproportionately low and not at all reflective of the level of socio-economic development. Table XIII demonstrates this clearly, by showing only one sector of the gross domestic product (GDP), the level of Merchandise Trade (Exports) for 1980.

TABLE XIII

Merchandise Trade - Exports 1980 (millions of dollars)

Oil		Non-Oil	
Iran	13.523	Israel	5,265
Algeria	12.409	Turkey	2,910
Iraq	26,429	Jordan	578
Kuwait	19,812	Tunisia	2,201
Libya	22,795	Lebanon	700
Saudi Arabia	109,111	Egypt	3,046
UAE	20,632	Sudan	543
		Yemen	44
		Morocco	2,403

As can be seen from the extreme difference in the level of income between the oil exporting countries and the non-oil exporting countries, any expenditure variable constructed as a percentage of the GDP, will, despite its relatively high absolute value (or high ratio in terms of non-oil GDP) will appear as a relatively low ratio to GDP because oil revenues comprise the major proportion of those countries total GDP.

Based on these considerations, private consumption was considered a much more representative indicator of development than the gross domestic product, consequently an inverse computation was performed using the variable Private Consumption, (resulting in the creation of a new variable which was labled PRIV1). Utilizing this new variable, PRIV1, the eight variables represented as a percentage of the GDP, were transformed into eight new variables, which were represented as a percentage of Private Consumption. Table XIV depicts these transformations.

Once the new variables were created they were inserted into the data set, replacing the original eight variables. At this point the analytical procedure was repeated using thirty variables. Table XV shows the results of the factor analysis utilizing the new variables.

As can be observed from Table XV, this time only six factors were retained which had an eigenvalue greater than 1.0, after the orthoganal rotation. The variables

TABLE XIV

Variable Transformations

New Variable		Computation	Replaced Variable New Variable
PRIV1	=	1/PRIVCON	
AGRI2	=	AGRIPROD x PRIV1	6
INDUS2	=	INDUSPRO X PRIV1	7
ADMIN2	=	ADMINGDP x PRIV1	8
MIWA2	=	MIWAELEC x PRIV1	9
GROSSIN2	=	GROSINV x PRIV1	14
GOVCON2	=	GOVCON x PRIV1	15
EXPER2	=	EXPERGDP x PRIV1	17
EDEX2	=	EDEXPEN x PRIV1	20

possessing the highest factor loadings in each of the six factors were:

1. Factor 1:- PRIVCON, private consumption as a percentage of the gross national product, (factor loading -.97266).
2. Factor 2:- PRIMED, primary education enrollment as a percentage of the total available population, (factor loading -.93802).
3. Factor 3:- GOVCONNE, government consumption as a percentage of the total national expenditures, (factor loading .87382)
4. Factor 4:- RADREC, radio receivers per 1000 inhabitants, (factor loading .91492).

TABLE XV

Results of Second Factor Analysis Using New Variables

FACTOR ANALYSIS OF MIDEAST SOCIO-ECONOMIC INDICATORS

ROTATED FACTOR PATTERN

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6
DIRTAX	-0.70957	-0.42874	0.42308	0.03048	-0.20981	-0.08806
INDIRTAX	-0.65262	0.02865	0.62032	0.00127	-0.15076	-0.19432
NONTAX	0.71650	0.45053	-0.39755	-0.02852	0.18436	0.07442
SECEXP	0.30872	-0.06859	0.16968	-0.11947	0.90687	-0.09021
GNPERCAP	0.59888	0.33705	0.01779	0.08879	0.08622	0.68222
AGRI2	-0.23256	-0.71452	-0.11705	-0.01903	-0.32412	-0.27687
INDUS2	0.93299	-0.06832	-0.03279	0.10278	0.15591	0.18467
ADMIN2	0.62854	-0.06869	0.60735	0.39343	0.06631	0.13015
MIWA2	0.94092	-0.05041	-0.05766	0.17290	0.14230	0.19141
NATSAV	0.72405	0.16534	-0.31923	-0.26269	0.11692	0.24944
GDPSOURC	0.78968	-0.12066	-0.05207	0.04948	0.21135	-0.41020
PRICONNE	-0.91560	-0.24353	0.07400	0.11522	0.07181	-0.06640
GOVCONNE	0.05161	0.22960	0.87382	-0.02646	0.31350	0.06910
GROSSIN2	0.85964	-0.22173	-0.01850	0.11935	0.07871	-0.37769
PRIVCON	-0.97266	-0.17635	-0.04315	0.03258	0.04183	-0.09371
GOVCON2	0.82858	-0.27509	0.07391	0.30565	0.14772	-0.25700
EXPER2	0.92763	-0.06514	-0.03030	0.18499	0.17470	0.18543
ECCACPOP	-0.07499	-0.83802	0.05759	-0.36841	0.01348	-0.20139
PUBEXED	-0.48432	-0.01268	-0.14768	-0.21663	-0.63551	-0.15060
EDEX2	0.82543	-0.03503	0.15842	-0.23958	0.23871	0.01498
FEMPRIM	-0.08175	0.90580	0.07203	0.15851	-0.20633	-0.10678
TERTED	-0.39812	0.48063	0.39209	0.44734	0.29029	-0.10160
FEMSECED	0.05015	0.66525	0.48990	-0.12450	-0.25202	0.27986
FEMTERDE	-0.21931	0.47512	0.75651	0.03609	0.19016	-0.01785
PRIMED	-0.09463	0.93802	0.06542	-0.07042	-0.15618	-0.13573
SECED	-0.06460	0.86387	0.29974	0.10254	0.18968	0.22147
PUPTEACH	-0.34724	-0.61345	-0.11925	-0.32886	-0.38764	-0.28953
ILLITER	0.01096	-0.44846	-0.30342	-0.76618	0.16101	0.12487
DAILNEWS	-0.06936	0.34062	0.53277	0.51890	0.01474	0.49441
RADREC	0.16815	0.06653	-0.13680	0.91492	0.07467	0.09090

ORTHOGONAL TRANSFORMATION MATRIX

	1	2	3	4	5	6
1	0.94851	0.13376	-0.06489	0.09953	0.22810	0.12765
2	-0.15927	0.82061	0.41933	0.28386	0.06349	0.20197
3	0.01973	-0.48279	0.72642	0.34633	0.32346	-0.11947
4	0.01843	0.08804	0.34713	-0.37527	0.21435	0.06884
5	0.27074	0.01393	0.40656	-0.14738	-0.83169	-0.21859
6	0.03059	0.26015	-0.08050	0.00059	0.22086	-0.93601

VARIANCE EXPLAINED BY EACH FACTOR

FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6
10.627231	6.055967	3.544593	2.746972	2.236573	1.762260

5. Factor 5- SECEXP, defense expenditures as a percentage of total government expenditures, (factor loading .90687).

6. Factor 6- GNPPRCAP, gross national product per capita, (factor loading .68222).

These six factors collectively account for 90 per cent of the total factor variance.

Using the six variables gleaned from the factor analysis, a cluster analysis was again conducted. The results of the cluster analysis proved to be totally perplexing. While factors 4,5, and 6 accounted for only 22 per cent of the total variance of the function, their influence on the subsequent clusters was disproportionately higher.

At this stage in the analysis it was felt the choice of the factors to be utilized in the discriminant analysis could be more subjective. The last three factors; radio receivers per 1000 inhabitants; defense expenditures as a percentage of total government expenditures ; and the gross national product per capita, due to the indiscriminate split in quantities and percentages between countries, tended to drastically skew the results, the decision to use them in the model was reviewed.

The problem with using radio receivers as a discriminant variable has been previously discussed. Since the quantity of receivers is presented in a raw format, rather than a percentage form, this variable has a tendency to drastically skew results. Defense expenditures, even though selected on a random basis, (the criteria being the most recent year with the largest complete data base), is not

really indicative of the level of development in any case because of constant inter-regional conflicts, security expenditures for individual countries tend to vary drastically year to year, depending upon the level of conflict experienced at a given time. Therefore for long range planning its value was also negligible. It was decided to not use these two variables in the discriminant analysis for the aforementioned reasons.

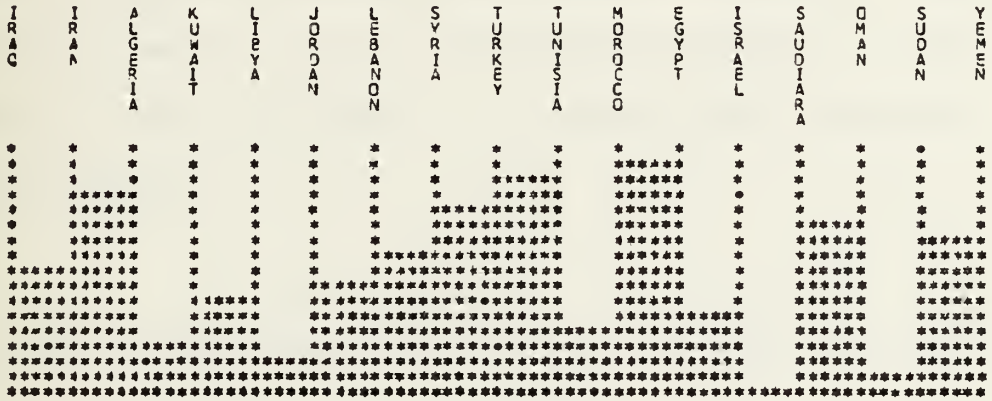
The decision to eliminate GNP per capita as one of the independent variables in the discriminant analysis, also served to help substantiate the overall model. Too often GNP per capita is utilized as the overall indicator of a country's level of development. While this may prove to be a viable indicator for the majority of the world, the Middle East appears to deviate from the norm. This is due, once again, to the significant difference in income between the oil producing countries and the non-oil countries.

Therefore taking the three remaining variables, a cluster analysis was once again conducted. These results are shown in Table XVI.

TABLE XVI

Results of the Cluster Analysis Based on Three Variables

CLUSTER ANALYSIS OF MIDEAST SOCIO-ECONOMIC INDICATORS
CLUSTER MAP



CLUSTER ANALYSIS OF MIDEAST SOCIO-ECONOMIC INDICATORS
CLUSTER LISTING

CLUSTER	COUNTRY	GOVCONNE	PRIVCON	PRIMED
1	IRAQ	16.8000	54.5000	120.0
1	IRAN	18.6000	41.3000	101.0
1	ALGERIA	14.0000	46.6000	98.0
1	MEAN	16.4667	47.4667	106.3
2	KUWAIT	21.1000	17.1000	99.0
2	LIBYA	21.4000	28.8000	123.0
2	MEAN	21.2500	22.9500	111.0
3	JORDAN	32.8000	80.8000	102.0
3	LEBANON	9.0000	86.0000	97.0
3	SYRIA	20.4000	66.2000	96.0
3	TURKEY	16.3000	71.2000	105.0
3	TUNISIA	15.9000	64.9000	102.0
3	MOROCCO	21.9000	69.5000	75.0
3	EGYPT	21.5000	63.8000	75.0
3	ISRAEL	40.8000	58.0000	96.0
3	MEAN	22.3250	70.0500	93.5
4	SAUDIARA	21.0000	13.6000	64.0
4	OMAN	18.1000	11.4000	44.0
4	MEAN	19.5500	12.5000	54.0
5	SUDAN	14.0000	80.6000	51.0
5	YEMEN	12.7000	93.1000	34.0
5	MEAN	13.3500	86.8500	42.5

As before, the next step was to take the six variables used in the cluster analysis and to subject them to a discriminant analysis. The SPSS stepwise discriminant program then scanned these variables, selecting those which best explained the variance between the means of the six groups, given the variables previously included. Table XVII shows the results of the discriminant analysis - all three variables being included in the discriminant analysis, none being excluded.

TABLE XVII

Stepwise Variable Selection for the 17 Countries

Variables included in the discriminant function

	F Ratios (to enter or remove)	Wilks Lambda
PRIVCON	38.675	0.15073
PRIMED	12.780	0.05593
GOVCONNE	1.017	0.01287

approximate F for function 10.91103

No variables were omitted from the discriminant function

sig .001

The two standardized 17 country functions in Table XVIII show Private consumption was the best discriminator followed by Primary education as a percentage of total enrollment. Government consumption as a percentage of total national expenditures followed respectively. These functions account for 99.17 percent of the overall total variance.

TABLE XVIII

Linear Discriminant Function

For the 17 Middle East Countries

non-standardized:

$Z_i = -4.682 + .135A_i - .455B_i + .551C_i$

$Z_i = -8.215 + .282A_i + .711B_i + .222C_i$

standardized:

$Z_i = 1.1309A_i - .5703B_i + .4291C_i$

$Z_i = .235A_i + .895B_i + .172C_i$

A = PRIVCON
B = PRIMED
C = GOVCONNE

The extent of usefulness of a given discriminant function depends, however, not only upon the reasonableness of the variables selected, and upon the percentage of discriminable variance for which these functions account, but also upon the extent of seperation among the groups. Table XIX shows there to be a clearly defined seperation between the groups, with an overall average probability of correct classification greater than 98 per cent. Table XIX, summarizes the results of the second analysis.

Having completed the analysis, taking into account certain factors peculiar to the Middle East, the countries can now be ranked in accordance with their discriminant scores. Unlike the Adleman and Morris study, which ranks countries with the largest discriminant scores as being the most developed, in this model, the lower discriminant score is indicative of a higher level of development.

By itself, this score is only an index of a level of development achieved at a certain point in time, to determine the potential for future development, further analysis is necessary.

TABLE XIX

Country Groupings Based Upon Second Discriminant Score

		Discriminant Score	Probability of Correct Class
Group I			
Iran		-2.65	99.8%
Algeria		-2.04	99.7%
Iraq		-1.82	97.5%
	mean	-2.17	
Group II			
Kuwait		-5.70	99.6%
Libya		-5.19	98.8%
	mean	-5.44	
Group III			
Tunisia		.355	84.9%
Syria		1.05	99.3%
Israel		1.06	99.9%
Turkey		1.09	99.0%
Egypt		1.74	99.9%
Morocco		2.53	99.8%
Lebanon		3.06	99.9%
Jordan		3.44	100%
	mean	1.79	
Group IV			
Saudi Arabia		-4.59	99.8%
Oman		-4.14	100%
	mean	-4.36	
Group V			
Sudan		4.7	99.9%
Yemen		7.09	100%
	mean	5.89	

TABLE XX

Countries of the Middle East - Level of Development

	Country	Discriminant Score
1.	Kuwait	-5.70
2.	Libya	-5.19
3.	Saudi Arabia	-4.59
4.	Oman	-4.14
5.	Iran	-2.65
6.	Algeria	-2.04
7.	Iraq	-1.82
8.	Tunisia	.355
9.	Syria	1.05
10.	Israel	1.06
11.	Turkey	1.09
12.	Egypt	1.74
13.	Morccco	2.53
14.	Lebanon	3.06
15.	Jordan	3.44
16.	Sudan	4.70
17.	Yemen	7.09

VI. TESTING THE MODEL

Measuring a country's development potential is a two phase operation. Each phase being related, yet clearly distinct from one another. The first phase involves measuring the amount, or the level of development as we have already done; the second phase entails measuring the rate of development.

In his paper, "Recent Rank Ordering of Nations in Terms of Level of Development" [Ref. 38], Kurt Finsterbusch argues that while several methods are very satisfactory for measuring a nation's level of development, no fully satisfactory method yet exists for the measurement of a nation's rate of development.

He argues, that it is impossible to measure the rate of development with one-tenth the accuracy obtainable in measuring the level of development, simply because no single system is reliable enough; no single factor indicative enough, since rates of change for aspects of development factor along at least three dimensions.

Finsterbusch does, however, attempt to develop an index, which combines ten rates of change of development series, into a rate of development index. This index, he says, produces a fairly reliable measure of the overall rate of

development. This development index is highly correlated with the rate of GNP per capita, (R-square= .73), with each indicator receiving additional legitimzation from this correlation [Ref. 39]. Utilizing this concept, it was decided to test our model's predictive capabilities in correlation with the rate of growth of the GDP. Since we are attempting to determine if a correlation exists between our index (discriminant score), and the rate of growth of GDP (read development), further analysis is necessary.

A. REGRESSION ANALYSIS

The method of analysis chosen for testing the relationship between level of development and the rate of growth was multiple regression analysis. The SAS STEPWISE Procedure being used is the Maximum R-Square Improvement Technique (MAXR), developed by James H. Goodnight [Ref. 40], and is considered superior to the normal stepwise regression, since it does not settle on a single model, rather it searches for the "best" one variable model; the "best" two variable model, etc.

The MAXR method begins by finding the one variable model producing the highest R-square. Then another variable, the one that would yield the greatest increase in R-square is added.

Once the two variable model is obtained, each of the variables in the model is compared to each variable not in the model. For each comparison, MAXR determines if removing one variable and replacing it with another variable, would increase R-squared. After comparing all possible switches, the one that produces the largest increase in R-square is made. This process continues until the best two variable model is created, then the process is repeated in order to achieve the best three variable model, the best four variable model, and so forth.

Through MAXR multiple regression techniques, a prediction equation is obtained which indicates how scores on the best independent variables could be weighted and summed to obtain the best possible prediction of a development rate for the countries of the Middle East.

The average annual rate of growth of the Gross Domestic Product between 1970 and 1979 was used as the dependent variable (non-oil GDP for the oil-exporting countries), in addition to the variables discriminate score (DISCRIM2), to assure that their impact on real growth would not be (incorrectly) attributed to the level of development.

B. SELECTION OF THE INDEPENDENT VARIABLES

Since the Arab world is a society undergoing profound changes, political as well as economic, it was felt that perhaps the level of political order in these countries could also have a certain degree of impact on a country's potential for socio-economic development.

Michael C. Hudson, in his book, Arab Politics [Ref. 41], states that the development of the political order is lagging behind the socio-economic changes. More precisely, instead of being able to direct them into fruitful policy outcomes, the political order is barely able to manage the social conflict which they engender.

> Because of an inability to generate structural legitimacy, Arab politics face two alternatives, neither of them desirable: either the emergence of control regimes whose stability is mainly a function of enhanced coercive capabilities or the re-emergence of the turbulence of the 1950's and the 1960's. What Arab opinion wants, and what social mobilization requires, is precisely what its political processes have been unable to provide: meaningful institutionalized participation [Ref. 42].

Hudson has developed a model (which he calls the social mobilization model), depicting the range of political choices as the product of a more complex set of factors. In theory, a given rate of social mobilization could give rise to four kinds of political order, depending on whether or not the political culture was highly fragmented along ethnic class lines and whether the government capabilities (relative to system loads) were high or low (see Figure 6.1).

Political systems with low fragmentation and low capabilities are relatively stable but inert. Low capability governments in highly fragmented societies give rise to an unstable order. Systems with high fragmentation, but also with high capabilities are designated as controlled. The final category, one marked by low fragmentation and high capabilities can realistically be considered suitable for the development of strong legitimacy [Ref. 43].

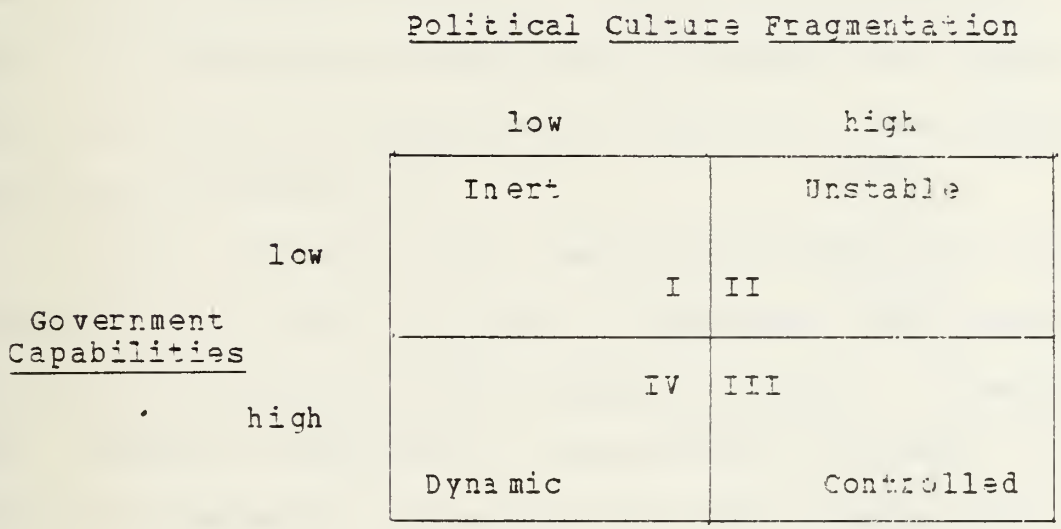


Figure 6.1 Hudson's Model of Social Mobilization.

Like Hudson, it was felt that the area of political development might play an important role in the overall socio-economic development of the Mid-eastern countries. Much has been done, especially in the revolutionary republics, to diminish social and economic inequalities. Not

only have the prerogatives of traditional elites been eliminated, governments have carried out substantial redistributions of national wealth through public policy. Tax reforms, free education, welfare programs, subsidies, rent controls and land redistribution has made a significant step in closing the gap of inequality in the past decade.

Since it was felt that the social mobilization model best described the Arab political process, an index was developed based upon Hudson's original design and the placement of the excluded countries (Iran, Turkey, Israel), based upon his definition of the political orders. The twenty one countries break down as shown in Figure 6.2 This independent variable was labled P1.

A long literature [Ref. 44] has contended that defense expenditures tend to divert resources from productive investments and thus impeed economic growth. A measure of the defense expenditures was therefore included in the regression equation to assure that this particular factor would not bias (one way or another) the impact of the discriminant score on the rate of growth.

As stated previously, defense expenditures, for any given year alone, had a tendency to be extremely misleading. It was decided however, an average of defense expenditures as both a percentage of the gross national product (DEFGNP) and as a percentage of total central government expenditures (DEFCGE) might prove to be a more valuable variable in our

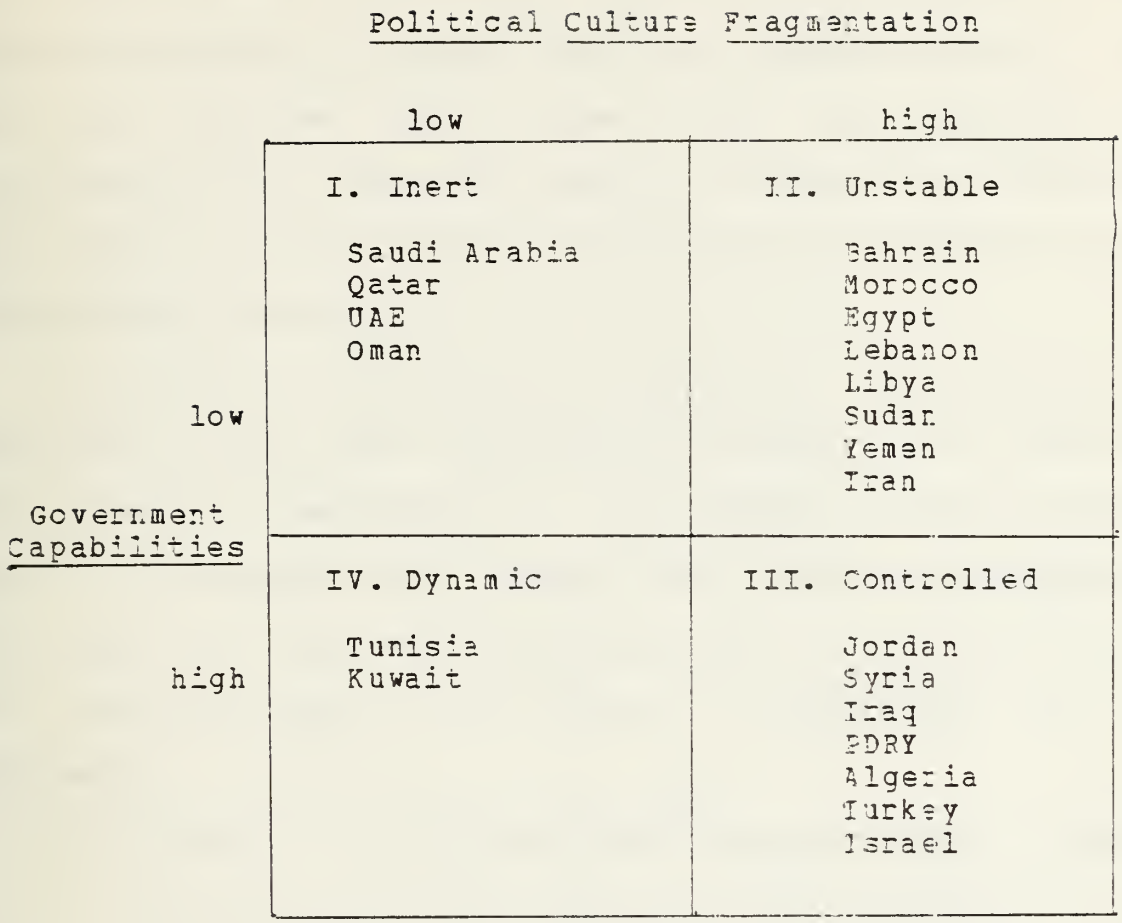


Figure 6.2 Levels of Political Development.

prediction equation. Using figures provided by the Arms Control and Disarmament Agency (ACDA) for the period 1970 - 1979, an average defense expenditure was computed, these two variables were also added to our list of independent variables subject to regression.

The Gross Investment Rate (GROSINV), as a percentage of the gross domestic product is traditionally utilized in the Western world as a primary source of economic growth. As with the case for defense expenditures this variable was included in the regression equation to assure that none of its impact on growth would be incorrectly attributed to the discriminate score.

In order to establish the validity of the selection of DISCRIM2 as the most representative indice of the level of development it was decided to, in addition, test the reliability of several other indices which had been developed in the course of this study yet intuitively determined not to be representative of the level of development in the Mid-east:

1. DISCRIM1 - the discriminant scores reached if radio receivers per 1000 inhabitants were included in the analysis.
2. DISCRIM3 - the discriminant score achieved based upon the single variable, GNP per capita.
3. CL1, CL2, CL3 - using the same variables that produced discriminant scores 1-3, a cluster analysis produced five seperate groups of countries. These groups were ranked accordingly 1-5, with 5 being the highest possible score.

A total of twelve possible functions were then present for testing as depicted in Table XXI.

TABLE XXI

The Twelve Functions Tested

1. RGGDP = f (DISCRIM1, DEFGNP, GROSINV, P1)
2. RGGDP = f (CL1, DEFGNP, GROSINV, P1)
3. RGGDP = f (DISCRIM2, DEFGNP, GROSINV, P1)
4. RGGDP = f (CL2, DEFGNP, GROSINV, P1)
5. RGGDP = f (DISCRIM3, DEFGNP, GROSINV, P1)
6. RGGDP = f (CL3, DEFGNP, GROSINV, P1)
7. RGGDP = f (DISCRIM1, DEFCGE, GROSINV, P1)
8. RGGDP = f (CL1, DEFCGE, GROSINV, P1)
9. RGGDP = f (DISCRIM2, DEFCGE, GROSINV, P1)
10. RGGDP = f (CL2, DEFCGE, GROSINV, P1)
11. RGGDP = f (DISCRIM3, DEFCGE, GROSINV, P1)
12. RGGDP = f (CL3, DEFCGE, GROSINV, P1)

C. CONDUCTING THE REGRESSION ANALYSIS

Of the twelve models tested only four produced a four variable model with an R-square value of any significance with the best function being:

RGGDP = f (DISCRIM2, DEFCGE, GROSINV, P1)

It was felt that the F-value should be significant at the 90 percent level. As can be seen from table XXII the two variables scoring the highest in the function are DISCRIM2, the discriminant score achieved through the development index, and P1, the level of political development, both meeting the criteria established for significance.

TABLE XXII

Results of the Regression Analysis

REGRESSION ANALYSIS OF SELECT INDEPENDENT VARIABLES
MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE RGGDP

STEP 1 VARIABLE DISCRIM2 ENTERED R SQUARE = 0.29881321 C(P) = 8.66004317

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	1	220.13861772	220.13861772	6.39	0.0232
ERROR	15	516.57117052	34.43807803		
TOTAL	16	736.70978824			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	9.96325798				
DISCRIM2	-1.00313204	0.39676142	220.13861772	6.39	0.0232

THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.

STEP 2 VARIABLE P1 ENTERED R SQUARE = 0.51426442 C(P) = 4.00463778

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	2	378.86362859	189.43181430	7.41	0.0064
ERROR	14	357.84615964	25.56043997		
TOTAL	16	736.70978824			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	18.86286696				
DISCRIM2	-0.68558764	0.34186060	214.17991536	8.38	0.0118
P1	-3.60222111	1.44554579	158.72501088	6.21	0.0259

THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.

STEP 3 VARIABLE DEFCGE ENTERED R SQUARE = 0.59293498 C(P) = 3.57446115

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	3	436.82100061	145.60700020	6.31	0.0071
ERROR	13	299.88878752	23.06836823		
TOTAL	16	736.70978824			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	12.622CE39E				
DISCRIM2	-1.12728254	0.33618562	259.37264761	11.24	0.0052
P1	-2.70CC8728	1.48654010	76.10605782	3.30	0.0924
DEFCGE	0.16418110	0.10358032	57.95737202	2.51	0.1370

THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.

STEP 4 VARIABLE GRGSINV ENTERED R SQUARE = 0.61153164 C(P) = 5.00000000

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	4	450.52134582	112.63033645	4.72	0.0160
ERROR	12	286.18844242	23.84903687		
TOTAL	16	736.70978824			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	9.70207364				
DISCRIM2	-1.14365401	0.34250859	265.89932162	11.15	0.0059
P1	-2.68788495	1.51156994	75.41117618	3.16	0.1007
DEFCGE	0.17253456	0.10389351	63.31175655	2.65	0.1292
GRGSINV	0.10737030	0.14166216	13.70034520	0.57	0.4631

THE ABOVE MODEL IS THE BEST 4 VARIABLE MODEL FOUND.

Defense expenditures as a percentage of the central government expenditures, significant probability score was positive although only at the 87 per cent level, while the investment rate as a percentage of the GDP, was clearly insignificant.

Since we are concerned with predicting the rate of growth from our four independent variables, the data gleaned from the regression analysis can now be employed to obtain the prediction equation:

$$RGGDP = 9.70 - 1.14A - 2.68B + .17C + .10D$$
$$(1.45) \quad (-3.33) \quad (-1.77) \quad (1.62) \quad (0.75)$$

A = DISCRIM2
B = P1
C = DEFCGE
D = GROSINV
() = T - score

The R-square score of .6115, indicates that 61 per cent of the time, the variation for the rate of growth of the GDP, is explained by the four independent variables operating jointly. However, as also can be seen from the equation, 51 per cent of the variation can be explained by the discriminant score and the level of political development alone. Therefore in the Middle East, defense expenditures, and to a greater extent, the percentage of gross investment, appear to have minor influence on the rate of growth, yet the variables which appear to explain the largest variation in growth, have a negative relationship to the growth rate.

VII. DISCUSSION OF THE RESULTS

While initially puzzling, the negative relationship between the two significant, independent variables and the rate of development is easily explained.

The negative relationship between the discriminant score and the rate of growth of the Gross Domestic Product (GDP), imply then, countries posessing the highest negative discriminate score were the most developed. The regression results therefore, in contrast to Finsterbusch, indicate that there is a clear relationship (at least for the Middle Eastern Countries), between the level of development and the overall rate of income growth.

The negative relationship between political development and the rate of growth most likely reflects the fact that while political development is indeed important to socio-economic growth, it alone will not insure a country's development.

In the study by Robert E. Looney and Peter C. Frederickson, "Defense Expenditures and Economic Growth" [Ref. 45], they hypothesized that the relationship between defense and growth will be positive and statistically significant for countries that are relatively resource unconstrained and the relationship would be negative and

statistically insignificant for those country's which are resource constrained. The linear regression equations estimated for these two groups of countries served to support their hypothesis.

The results from the Looney and Frederickson study can perhaps provide a clue to the end results of our model. While the level of political development plays an important part in the overall rate of development for a country, (a trend that was prevalent in all the prediction equations tested; P1 was always the best one variable model except when compared to DISCRIM2 and CL2, when it was second), it is statistically insignificant compared to the level of economic development as portrayed by our discriminant score.

In other words, a country with development potential (read low discriminant score) can continue to grow in spite of the political level of development, while a country which already rests at a low level of development (read high discriminant score) will not grow simply because of a dynamic political system. The highest development potential, therefore, rests with the resource unconstrained countries.

Graphically depicted, our model of social economic development in the Middle East can be represented as shown in Figure 7.1.

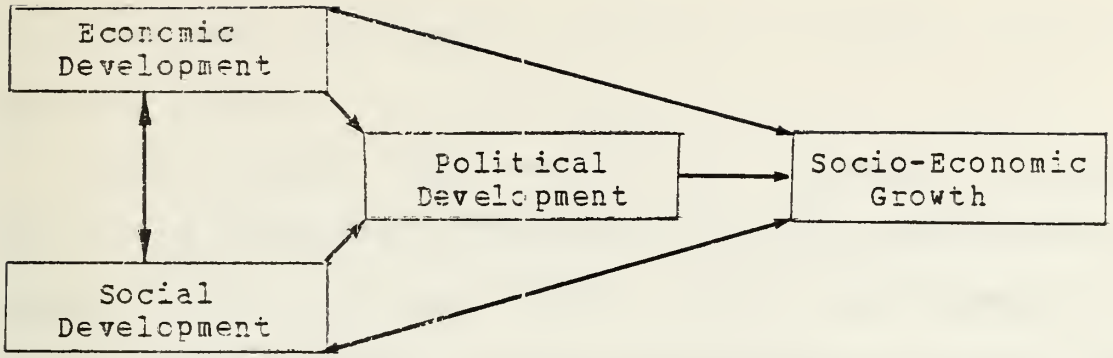


Figure 7.1 A Mideast Model of Socio-Economic Development.

The model further demonstrates that while the level of development is related to the rate of growth, the relationship is not exceptionally strong. In order to design a model capable of achieving a higher level of significance it may be necessary to enter additional variables that were beyond the scope of this study. For example, constraints that are placed on the domestic economy such as labor constraints and capital constraints (of special importance to the non-oil countries); another factor which might bear investigation is the impact of foreign demand for Mid-Eastern products as well as domestic supply factors.

A country's balance of payments includes much more than the exports of goods and services and complementary imports. It also includes payments on foreign indebtedness and receipts from foreign investments, private remittances and un-requited government transfers. Such items can compete with or supplement the foreign resources available for

socio-economic development and thus can further constrain domestic growth.

Another factor that has not been addressed, primarily due to the inability to quantify it for the purposes of this study, though its importance to overall development in the region is unargueable, is the potentiality of further political violence, i.e. Arab-Israeli confrontations; domestic political discord; the effect of the Islamic Fundamentalist Movement. While the P1 variable can assist us in measuring a level of political development, and our discriminant score can measure a level of socio-economic development, there has yet to be devised a scale which will accurately measure the impact of a country's ideological fervor.

VIII. CONCLUSION

The previous study on the identification of relative levels of development of Middle Eastern countries performed by Hershlag and Kloner, was, although a pioneering work in the field of quantitative analysis in the Middle East, nevertheless of limited scope. The current study, by utilizing an expanded data base together with discriminant analysis and multiple regression techniques, extended that study not only to the present time period, but in scope as well. The end result is a more comparative picture of the countries of the Middle East, showing their relative development since the initial study was completed. A compairison of the countries rankings from the first study to the present, does indeed present some significant differences. The main one being the rise in the development level of the oil producing countries.

The goal of this study was to establish a model to aid the policy analyst in the determination of a country's growth potential. Through a detailed process of multivariate analysis an index of the country's level of development was achieved, with their subsequent ranking based upon their discriminate score. Through regression analysis this index was tested along with several other independent variables,

to determine its reliability as a model of development as well as determine the correlation between the index and other commonly identified variables asscociated with the growth process. The result achieved was a predictive equation with the level of development and an index of political development accounting for over 61 percent of the fluctuations in real growth of the sample countries. Our model, therefore, does indeed have predictive potential.

The fact that the predictive potential of the model is however somewhat limited, in no way detracts from its importance and its overall utility value. Since the amount of empirical research conducted in the Middle East in the area of social-economic development is extremely small, any additional research performed vastly assists the area analyst in the conduct of his work.

The difficulties and problems encountered in the attempt to quantify the data from the Middle East, as well as the failure of those country's under study to fit the already established and well worked models of social development, assist in highlighting the need for more quantitative work in the region.

Areas of future study should include:

1. The extreme sensitivity of the model due to the selection of variables. By expanding the size of the total number of variables to be used in the initial factor analysis, and/or using ten year averages

opposed to the most recent data available, trends of economic development may become more apparent.

2. The effects of political development vs socio-economic development.
3. The effects of a failure to achieve a lasting peace in the Middle East on long range social-economic development.

By utilizing this model as a foundation for future research and continuing to refine and work with it, its value will continue to increase.

APPENDIX A

DATA ON SELECTED SOCIO-ECONOMIC VARIABLES IN THE MIDDLE EAST

STATISTICAL ANALYSIS SYSTEM

COUNTRY	CIRTAX	INCTAX	NONTAX	SECEF	GNPPRCAP	AGRIPRCD	INDUSPRD	ADMINGDP	MIWAELEC	NATSAV	GDPSOURC	PRICONNE	GCVCONNE	GPCSINV
IRAQ	18.7	4.0	81.3	33.6	2203	7.0	73.0	8.4	52.5	21.3	5.7	33.2	16.8	25.7
IRAN	24.1	3.6	75.9	29.4	1990	11.1	11.8	10.5	30.8	38.9	12.8	45.2	18.6	27.1
JORDAN	82.1	14.5	17.9	43.2	1173	8.0	32.0	22.1	5.0	10.9	6.3	86.4	32.8	36.7
KUWAIT	6.3	0.0	93.7	19.8	16600	0.5	79.0	9.4	70.0	46.6	7.1	23.7	21.1	8.0
LEBANON	60.0	7.5	40.0	19.6	900	9.9	13.9	8.1	13.9	14.8	6.3	87.1	9.0	30.5
LIBYA	16.5	2.8	83.5	20.8	7323	2.0	72.0	6.9	56.3	45.2	7.6	27.9	21.4	25.0
SAUDIARA	23.4	1.3	76.6	56.9	3940	1.0	78.0	5.1	56.8	61.8	16.4	22.8	21.0	19.4
SUDAN	84.5	5.3	15.5	13.6	341	38.0	14.0	12.3	0.6	1.6	1.2	79.2	14.0	13.8
SYRIA	32.8	4.7	67.2	29.4	1006	20.0	27.0	11.6	10.2	15.7	9.3	62.3	20.4	28.0
TURKEY	93.2	10.4	6.8	15.6	1319	23.0	30.0	11.6	1.2	18.2	6.8	68.2	16.3	22.4
UAE	.	.	.	55.1	14100	1.0	77.0	.	2.5	66.9	.	.	.	.
OMAN	31.4	0.8	68.6	35.8	2621	4.2	63.7	7.8	54.6	30.1	19.4	21.0	18.1	28.2
MOROCCO	85.9	10.4	14.1	16.3	2621	18.0	27.0	10.5	5.2	12.3	4.1	68.0	21.9	23.9
BAHRAIN	2.1	2.8	86.9	18.6	4150	1.2	6.9	.	2.6	25.3	.	.	.	.
QATAR	.	.	.	.	14270	1.1	3.6	.	2.6	.	12.3	.	.	.
YEMEN	83.1	6.4	9.4	17.5	659	29.0	16.0	9.0	1.0	31.3	6.4	92.4	12.7	19.6
PERU	72.0	7.2	28.0	49.2	504	13.0	28.0	10.7	1.4	24.3	4.2	.	.	.
EGYPT	76.8	9.3	23.2	8.8	470	23.0	24.0	25.3	21.5	22.0	4.4	61.4	21.5	20.4
ALGERIA	46.9	7.0	51.1	8.8	1392	6.0	57.0	12.0	25.8	37.4	7.4	43.4	14.0	46.2
TUNISIA	84.1	15.2	14.9	4.2	1074	17.0	35.0	13.2	18.6	14.4	9.4	64.3	15.9	26.2
ISRAEL	86.3	15.2	11.7	28.9	3913	5.0	36.0	40.0	21.8	6.7	6.0	65.5	40.8	22.3

COUNTRY	PRIVCON	GOVCON	EXPERCDP	ECACDP	PUBEXED	[illegible]	FEMPRIM	FEMSECED	FEMTERED	PRIMED	SECED	TERTED	PUPTEACH	ILLITER	DAILNEWS	RADPEC
IRAQ	54.5	38.0	53.4	41.5	6.9	4.3	72	30	31	120	56	9	28	75.8	22.0	113.1
IRAN	41.3	20.4	33.9	40.0	14.1	5.7	77	36	31	101	44	5	31	63.1	15.0	62.3
JORDAN	80.8	35.1	37.3	27.3	9.5	6.1	79	43	41	102	74	27	36	67.6	29.0	194.8
KUWAIT	17.1	15.0	80.8	1.7	5.9	2.7	87	46	28	99	74	12	16	40.4	159.0	460.8
LEBANON	86.0	6.0	42.7	11.5	18.6	2.5	109	32	23	97	50	28	23	14.0	84.0	460.4
LIBYA	26.8	23.0	55.7	18.3	13.0	6.0	147	39	19	123	67	6	23	49.9	26.0	47.0
SAUDIARA	13.6	17.4	69.9	61.4	11.6	8.2	34	36	23	64	31	7	24	97.5	11.0	29.4
SUDAN	80.6	12.7	19.0	77.9	15.7	6.3	30	34	21	51	16	2	47	85.3	8.0	73.4
SYRIA	66.2	19.3	20.3	48.2	9.8	5.8	85	35	28	96	47	18	33	60.0	11.0	224.0
TURKEY	71.2	13.1	4.1	57.2	19.9	3.6	94	32	25	105	34	19	34	39.7	41.0	104.2
UAE	18.8	16.2	82.4	2.0	19.1	1.9	32	43	42	70	78	.	14	79.1	8.0	234.0
OMAN	11.4	39.5	64.0	62.8	4.9	3.7	25	20	15	44	2	2	35	44.0	0.0	421.0
MOROCCO	69.5	16.4	18.0	52.3	15.6	6.4	47	37	21	75	22	4	40	78.6	21.0	80.0
BAHRAIN	.	.	81.3	8.1	8.8	4.3	43	47	43	62	72	.	42	59.8	0.5	270.3
QATAR	.	.	76.9	.	3.3	4.2	101	47	58	112	82	.	18	90.0	80.0	413.0
YEMEN	93.1	11.6	5.7	75.9	11.9	1.2	7	11	12	34	4	2	38	97.5	10.0	141.0
PERU	.	.	36.2	59.5	16.8	3.8	48	11	30	70	31	2	30	72.9	16.0	57.8
EGYPT	63.8	25.2	18.3	61.2	16.8	4.1	56	37	30	75	48	15	40	56.5	79.0	136.4
ALGERIA	46.6	14.6	33.0	51.9	17.3	3.7	72	37	24	98	31	4	41	73.6	13.0	178.7
TUNISIA	64.9	14.7	25.8	42.3	18.6	6.4	81	36	28	102	25	5	40	62.0	33.0	140.6
ISRAEL	58.0	36.0	37.6	45.1	8.3	8.9	97	42	50	96	68	26	17	11.0	203.0	189.0

OBS	COUNTRY	PRIV1	AGPI2	INCLS2	ADMIN2	MIWA2	GRCSSIN2	GOVCON2	EXPER2	EDEX2
1	IRAQ	0.018	0.128440	1.33	0.154128	0.56	0.47156	0.69725	0.97	0.078
2	IRAN	0.024	0.26	0.28	0.254237	0.74	0.65	0.49	0.82	0.13
3	JORDAN	0.012	0.09	0.39	0.273515	0.06	0.47	0.43	0.46	0.07
4	KUWAIT	0.05	0.02	4.61	0.549708	4.09	0.46	0.87	4.72	0.15
5	LEBANON	0.011	0.11	0.16	0.094	0.16	0.35	0.10	0.49	0.02
6	LIBYA	0.03	0.06	2.50	0.23	1.95	0.86	0.79	2.07	0.20
7	SAUDIARA	0.07	0.07	5.73	0.375	4.17	1.42	1.27	5.12	0.60
8	SUDAN	0.012	0.47	0.17	0.165	0.06	0.17	0.16	0.16	0.07
9	SYRIA	0.015	0.30	0.40	0.175	0.15	0.42	0.29	0.30	0.08
10	TURKEY	0.014	0.32	0.42	0.162	0.01	0.31	0.18	0.05	0.05
11	UAR	0.08	0.36	5.58	0.684	4.78	2.47	3.46	5.61	0.32
12	MOROCCO	0.014	0.25	0.38	0.151	0.07	0.34	0.23	0.25	0.09
13	YEMEN	0.01	0.31	0.17	0.096	0.01	0.21	0.12	0.06	0.01
14	EGYPT	0.015	0.36	0.37	0.396	0.23	0.31	0.39	0.28	0.06
15	ALGERIA	0.02	0.12	1.22	0.257	0.55	0.99	0.31	0.70	0.07
16	TUNISIA	0.015	0.26	0.53	0.203	0.28	0.40	0.22	0.39	0.09
17	ISRAEL	0.017	0.086207	0.62069	0.689655	0.27586	0.38448	0.62069	0.64828	0.153448

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